Aquarium Portal Technique for PASTA Lesion Repair

Meyer, Dominik C ; Gerber, Christian ; Familiari, Filippo

Abstract: The simultaneous arthroscopic exposure of the subacromial and intra-articular space of the shoulder is challenging in the presence of only partial-thickness rotator cuff tears. We present our experience and method of entering the joint through the opened rotator cuff interval from an anterosuperior portal between the coracoid process and anterior acromion. With moderate (approximately 30°) abduction and external rotation, the rotator interval opens readily, offering a view with the camera toward the anterior edge of the supraspinatus tendon. An anterior view on the anterior leading edge of the supraspinatus tendon is obtained, showing the subacromial space above and the glenohumeral space below the tendon, similar to the view in an aquarium. The rotator cuff can be elevated using a rod inserted intra-articularly from posterior, whereas anchors and other instruments may be inserted from lateral. This approach offers the advantages of full exposure of the posterior undersurface of the rotator cuff insertion; a convenient approximately 90° angle between the camera and instruments; and no need to change portals for anchor placement, tendon stitching, or suture handling. The objective of this Technical Note is to describe our arthroscopic repair approach (aquarium technique) to PASTA (partial articular supraspinatus tendon avulsion) lesions.

DOI: https://doi.org/10.1016/j.eats.2017.06.015

Aquarium Portal Technique for PASTA Lesion Repair

Dominik C. Meyer, M.D., Christian Gerber, M.D., F.R.C.S.Ed.(Hon), and Filippo Familiari, M.D.

Abstract: The simultaneous arthroscopic exposure of the subacromial and intra-articular space of the shoulder is challenging in the presence of only partial-thickness rotator cuff tears. We present our experience and method of entering the joint through the opened rotator cuff interval from an anterosuperior portal between the coracoid process and anterior acromion. With moderate (approximately 30°) abduction and external rotation, the rotator interval opens readily, offering a view with the camera toward the anterior edge of the supraspinatus tendon. An anterior view on the anterior leading edge of the supraspinatus tendon is obtained, showing the subacromial space above and the glenohumeral space below the tendon, similar to the view in an aquarium. The rotator cuff can be elevated using a rod inserted intra-articularly from posterior, whereas anchors and other instruments may be inserted from lateral. This approach offers the advantages of full exposure of the posterior undersurface of the rotator cuff insertion; a convenient approximately 90° angle between the camera and instruments; and no need to change portals for anchor placement, tendon stitching, or suture handling. The objective of this Technical Note is to describe our arthroscopic repair approach (aquarium technique) to PASTA (partial articular supraspinatus tendon avulsion) lesions.

Partial-thickness rotator cuff tears are responsible for significant shoulder pain and limitation of function.[1] According to Ellman,[2] partial-thickness rotator cuff tears can be classified based on arthroscopic findings and on the location of the tear (A, articular; B, bursal; and C, intratendinous), as well as the depth of the tear (grade 1, <3 mm; grade 2, 3-6 mm; and grade 3, >6 mm). Articular-sided partial-thickness rotator cuff tears of the supraspinatus tendon were termed PASTA (partial articular supraspinatus tendon avulsion) by Millstein and Snyder.[3]

Previous articles have reported that when these lesions are left untreated, they have limited potential for spontaneous healing, as shown by the absence of the repair process at the site of injury and the presence of areas of degenerative changes and vascular proliferation.[4] Moreover, PASTA lesions progress to full-thickness tears in 28% of cases, with an enlargement of tear size in 50% of cases.[5] The current literature suggests that when conservative management fails, surgical intervention is indicated in symptomatic patients with partial tears involving more than 50% of the tendon thickness.[6]

There is no consensus in the literature regarding the ideal technique for treatment of PASTA lesions, although many techniques have been described (i.e.,

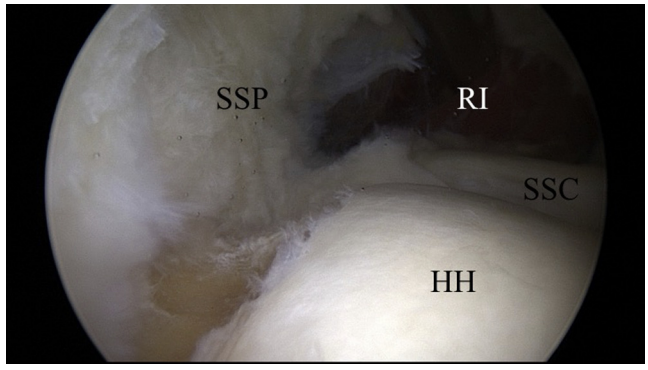

Fig 1. Arthroscopic view from the posterior portal in a left shoulder with the patient in the beach-chair position showing a PASTA (partial articular supraspinatus tendon avulsion) lesion. (HH, humeral head; RI, rotator interval; SSC, subscapularis; SSP, supraspinatus.)

From the Department of Orthopaedics, Balgrist University Hospital, University of Zurich (D.C.M., C.G., F.F.), Zurich, Switzerland; and Department of Orthopaedic and Trauma Surgery, Magna Graecia University (F.F.), Catanzaro, Italy.

The authors report the following potential conflict of interest or source of funding: C.G. receives support from Zimmer. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received March 3, 2017; accepted June 15, 2017.

Address correspondence to Dominik C. Meyer, M.D., Department of Orthopaedics, Balgrist University Hospital, University of Zurich, Forchstrasse 340, Zurich CH-8008, Switzerland. E-mail: dominik.meyer@balgrist.ch

2212-6287/17292

http://dx.doi.org/10.1016/j.eats.2017.06.015

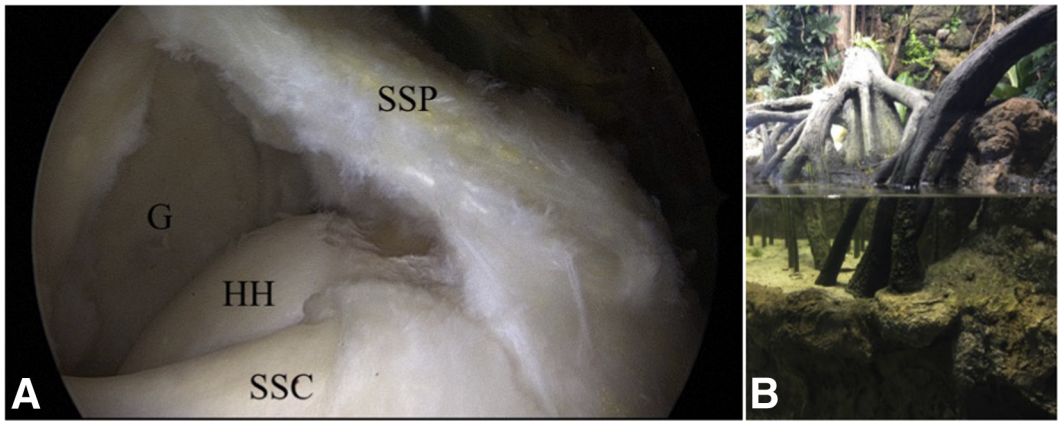

Fig 2. (A) Arthroscopic view from the aquarium portal in a left shoulder with the patient in the beach-chair position showing a PASTA (partial articular supraspinatus tendon avulsion) lesion. (G, glenoid; HH, humeral head; SSC, subscapularis; SSP, supraspinatus.) (B) Pictorial representation of the aquarium portal, similar to a real aquarium, in which a view above and below the waterline at the same time is possible.

debridement and subacromial decompression, tear completion and complete repair, transtendon repair, and transosseous repair). Despite all these options, there is no evidence of the superiority of one technique over the others. If repair is needed, correct positioning of sutures should be pursued. It has been shown that stitch positioning influences the suture hold in supraspinatus tendon repairs; therefore, it may be desirable to identify the rotator cable and to pass sutures just medial to it, close to the middle of the tendon, which has been shown to provide the highest possible suture-retention properties.[7] This Technical Note describes our arthroscopic repair approach (aquarium technique) to PASTA lesions (Video 1).

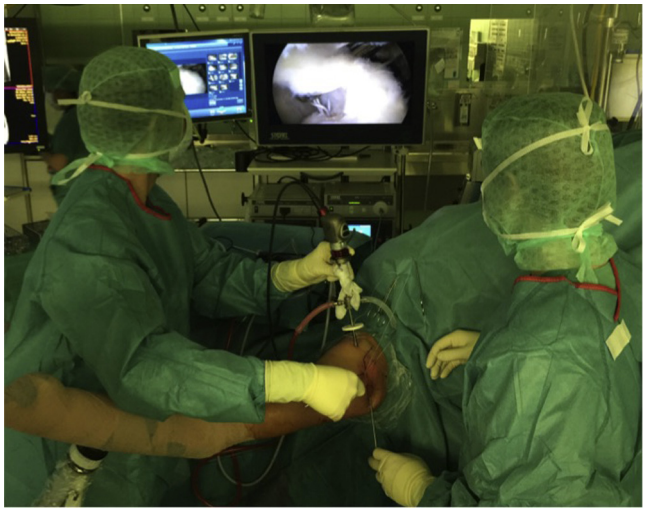

Fig 3. Position of surgeon. The surgeon is standing between the abducted arm and patient's body, and an operating-side table above the patient's chest is used as a comfortable armrest for the camera-holding hand.

Surgical Technique

Patient Positioning and Preoperative Setup

With the patient in the beach-chair position with administration of a regional interscalene nerve block, the operative arm is placed in approximately 20° of abduction, forward flexion, and 0° to 20° of external rotation (Spider Limb Positioner; Smith & Nephew, Andover, MA). The index shoulder is prepared and draped in a routine sterile fashion.

Diagnostic Arthroscopy

Diagnostic arthroscopy is performed with a 30° arthroscope viewing through a standard posterior portal. A PASTA lesion may be combined with a lesion of the long head of the biceps tendon. Either tenotomy or tenodesis of the biceps can be performed depending on the age, gender, and functional requirements of the patient.

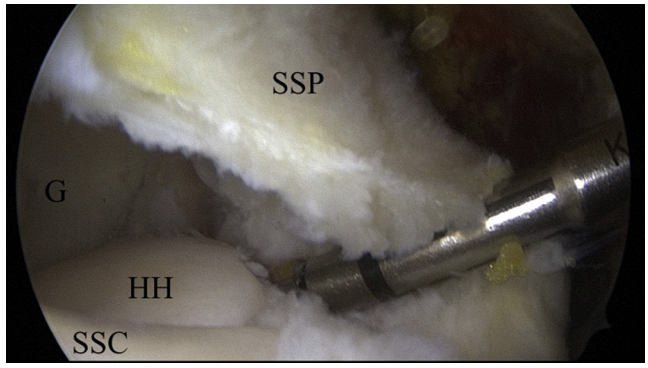

Fig 4. Arthroscopic view from the aquarium portal in a left shoulder with the patient in the beach-chair position. A double-loaded suture anchor (6.5-mm titanium suture anchor) is placed through the interval (or in a transtendinous manner) into the supraspinatus (SSP) footprint. (G, glenoid; HH, humeral head; SSC, subscapularis.)

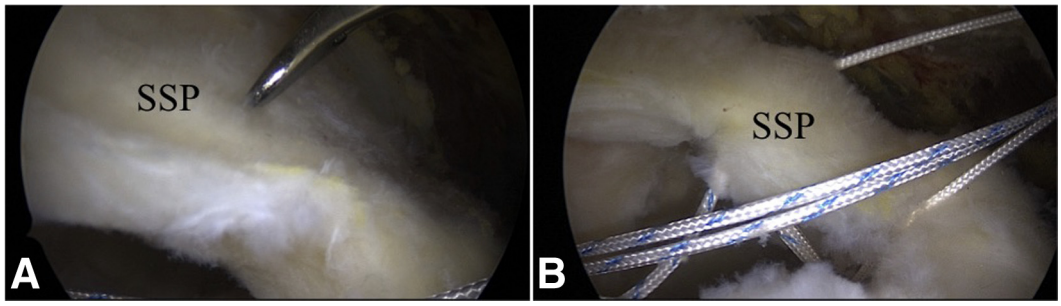

Fig 5. Arthroscopic view from the aquarium portal in a left shoulder with the patient in the beach-chair position. (A) A tendon-penetrating suture grasper (Cleverhook) is used to penetrate the full thickness of the supraspinatus (SSP) tendon from the bursal side toward the articular side under direct visualization both extra- and intra-articularly to precisely check for suture positioning. (B) The suture limbs are then retrieved through the posterior portal. (SSP, supraspinatus.)

Arthroscopic Portal Placement

An anterior working portal is established through the rotator interval (i.e., the capsule between the superior glenohumeral ligament and the middle glenohumeral ligament). By use of an 18-gauge spinal needle with an outside-in technique, a standard anterosuperior portal is created just lateral and superior to the tip of the coracoid and a high lateral portal is created at the midglenoid level in the sagittal plane. If the indications for a rotator cuff repair are met, proper glenohumeral debridement, involving the rotator interval but sparing the comma sign and ventral biceps pulley, is usually performed. Through the anterosuperior portal, debridement of the supraspinatus insertion is performed (5.5-mm Aggressive Pro Line; Karl Storz, Tuttlingen, Germany) to create a bleeding bed. After subacromial decompression, acromioplasty if needed, and bursectomy, the status of the rotator cuff is assessed and the diagnosis of a PASTA lesion is definitively made. Attention is then turned to assessment and repair of the PASTA lesion (Fig 1).

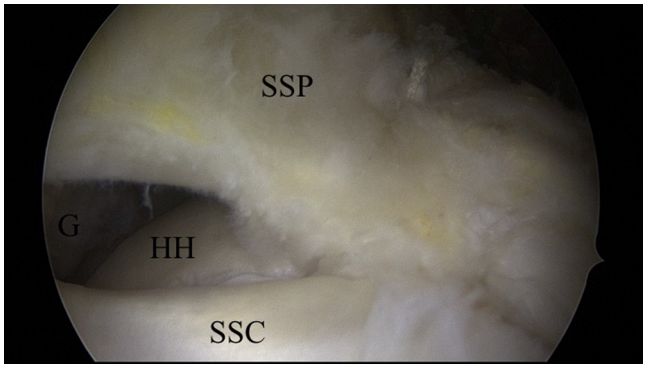

Fig 6. Arthroscopic view from the aquarium portal in a left shoulder with the patient in the beach-chair position showing repair of the supraspinatus (SSP) with a single-row mattress technique and with full coverage of the footprint. (G, glenoid; HH, humeral head; SSC, subscapularis.)

Aquarium Portal Technique

With the arthroscope in the lateral portal, subacromial debridement, acromioplasty if needed, and bursectomy are completed. The arthroscope is inserted through the anterosuperior portal just lateral to the coracoid. With the rotator interval open, an anterior view on the anterior leading edge of the supraspinatus tendon is obtained, showing the subacromial space above and the glenohumeral space below the tendon, similar to the view in an aquarium, in which a view above and below the waterline (represented by the tendon) at the same time is possible (Fig 2). If exposure is insufficient, a slight increase in external rotation and abduction may help. The position of the surgeon is now most convenient standing between the abducted arm and patient's body; an operating-side table above the patient's chest may be used as a comfortable armrest for the camera-holding hand (Fig 3). With a switching stick through the posterior portal through the joint capsule, the tendon may be manipulated and visualization

Table 1. Pearls and Pitfalls

Pearls
If exposure is insufficient, a slight increase in external rotation and abduction may help.
The position of the surgeon is most convenient standing between the abducted arm and patient's body; an operating-side table above the patient's chest may be used as a comfortable armrest for the camera-holding hand.
With a switching stick through the posterior portal through the joint capsule, the tendon may be manipulated and visualization improved if needed.
Anchor placement may be through the tendon or the rotator interval.
Pitfalls
Reduced exposure may occur with coracoid tips that reach far laterally, in which case a resection of the coracoacromial ligament may be considered.
The size of the rotator interval may be overestimated because of the proximity of the camera. Normal resection as for subscapularis repair will suffice.
If the biceps tendon is left intact, the operation is still possible but exposure may be somewhat more difficult.

Table 2. Advantages and Disadvantages

Advantages
There is no need to change portals for anchor placement (which may be performed in a transtendinous manner or through the interval), tendon stitching, or suture handling.
Simultaneous full exposure of the bursal and articular surfaces of the rotator cuff with the full bony insertion is possible.
A convenient approximately 90° angle between the camera and instruments is provided.
Disadvantages
The rotator interval has to be, at least in part, open.
Tenotomy or tenodesis of the long head of the biceps tendon will sometimes be strongly preferred.
A small learning curve is possibly necessary to become fully comfortable.

improved if needed. By use of this view, from the high lateral portal, it is possible to place a double-loaded suture anchor (6.5-mm titanium suture anchor; Karl Storz) either in a transtendinous manner or through the interval into the supraspinatus footprint (Fig 4). After anchor insertion, with the use of a tendon-penetrating suture grasper, such as the Cleverhook (DePuy Mitek, Raynham, MA), the full thickness of the supraspinatus tendon from the bursal side toward the articular side may be penetrated under direct visualization both extra- and intra-articularly to precisely check for suture positioning (Fig 5). The suture limbs are then retrieved through the posterior portal, and suture tying is performed to the footprint according to the surgeon's preference.

Finally, the repair can be assessed, first from the anterosuperior portal and then from the posterior transtendinous portal. The supraspinatus tendon appears anatomically repaired (Fig 6). Table 1 shows pearls and pitfalls of our technique, and Table 2 lists advantages and disadvantages.

Discussion

Arthroscopic rotator cuff repair techniques have evolved over the past few decades, for both partial- and full-thickness tears. For the treatment of partial articular-sided tears, however, we believe that a straightforward technique that allows the surgeon to fully control the position of tools and implants during suture stitching simultaneously on both sides of the tendon is missing. Most surgeons perform stitching by looking from subacromial. The proposed "aquarium" approach from anterosuperior through the previously opened rotator interval provides full exposure of the posterior supraspinatus insertion also and allows the surgeon to look at the tendon either intra-articularly or subacromially without changing the portal. Furthermore, a convenient approximately 90° angle between the camera and instruments is provided, and there is no need to change camera portals for anchor placement (which may be performed in a transtendinous manner or through the interval), tendon stitching, or suture handling.

There are various ways to address PASTA lesions, such as debridement and subacromial decompression for tears of less than 50% of the tendon width. However, this technique is far from any attempt to restore the native function of the injured supraspinatus tendon. Completing the tear of the remaining tendon, followed by performing a standard rotator cuff repair, is technically simple and straightforward. Favorable clinical and anatomic results of this technique have been reported.[4] However, advocates of tear completion express concern over the quality of the residual tendon tissue, as well as inferior mechanical repair strength. Our technique allows the surgeon to relatively conveniently perform a repair of only the torn portion of the tendon, preserving the intact rotator cuff tissue laterally, with the length-tension balance of the rotator cuff closer to the normal anatomy. Moreover, it has been suggested that this technique would have advantages related to superior biomechanical properties (footprint coverage, inferior gapping, and superior failure strength) and histologic features compared with tear completion and repair.[8,9]

The main limitations of our technique are that the rotator interval has to be, at least in part, open and tenotomy or tenodesis of the long head of the biceps tendon is beneficial to obtain full vision and access for the repair. The major risks with our technique are similar to those of other arthroscopic rotator cuff repairs: repair failure, stiffness, and infection. In the first 20 procedures performed at our institution, once intraoperatively decided and initiated, the repair could always be performed and completed with the described technique. Furthermore, to date (follow-up of 2-24 months), no reoperation has been necessary in any of the patients. However, except for the improved viewing angle, as well as improved precision for anchor and suture placement, no relevant changes have been made to our former preparation technique for PASTA repair, and it remains for a formal prospective study to analyze the potential benefits in clinical outcome.

In conclusion, the aquarium approach described in this article offers the advantages of simultaneous full exposure of the bursal and articular surfaces of the rotator cuff with the full bony insertion; a convenient approximately 90° angle between the camera and instruments; and no need to change portals for anchor placement (which may be performed in a transtendinous manner or through the interval), tendon stitching, or suture handling.

References

1. Vinanti GB, Rossato A, Scrimieri D, Petrera M. Arthroscopic transtendon repair of partial articular-sided

supraspinatus tendon avulsion. *Knee Surg Sports Traumatol Arthrosc* 2017;25:2151-2156.
2. Ellman H. Diagnosis and treatment of incomplete rotator cuff tears. *Clin Orthop Relat Res* 1990;(254):64-74.
3. Millstein ES, Snyder SJ. Arthroscopic evaluation and management of rotator cuff tears. *Orthop Clin North Am* 2003;34:507-520.
4. Yamakado K. Histopathology of residual tendon in high-grade articular-sided partial-thickness rotator cuff tears (PASTA lesions). *Arthroscopy* 2012;28:474-480.
5. Yamanaka K, Matsumoto T. The joint side tear of the rotator cuff. A followup study by arthrography. *Clin Orthop Relat Res* 1994;(304):68-73.
6. Strauss EJ, Salata MJ, Kercher J, et al. Multimedia article. The arthroscopic management of partial-thickness rotator cuff tears: A systematic review of the literature. *Arthroscopy* 2011;27:568-580.
7. Wieser K, Rahm S, Farshad M, Ek ET, Gerber C, Meyer DC. Stitch positioning influences the suture hold in supraspinatus tendon repair. *Knee Surg Sports Traumatol Arthrosc* 2013;21:1587-1592.
8. Ide J, Maeda S, Takagi K. Arthroscopic transtendon repair of partial-thickness articular-side tears of the rotator cuff: Anatomical and clinical study. *Am J Sports Med* 2005;33:1672-1679.
9. Gonzalez-Lomas G, Kippe MA, Brown GD, et al. In situ transtendon repair outperforms tear completion and repair for partial articular-sided supraspinatus tendon tears. *J Shoulder Elbow Surg* 2008;17:722-728.